



Human Systems Integration (HSI) in Acquisition

Integrating
Human Concerns
into Life Cycle
Systems Engineering

Management Guide

HSI Domain and Acquisition Phase Guides also Available

Report Documentation Page				Form Approved OMB No. 0704-0188	
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14. ABSTRACT Human Systems Integration (HSI) encompasses the interdisciplinary technical and management processes for integrating human considerations within and across all system elements; an essential enabler to systems engineering practice. HSI processes facilitate trade-offs among human-centric domains without replacing individual domain activities, responsibilities, or reporting channels. The human-centered domains with recognized application to HSI include: Manpower, Personnel, Training, Human Factors Engineering, Survivability, Safety, Occupational Health, and Habitability.					
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taken from the International Council on Systems Engineering (INCOSE) [Systems Engineering Handbook](#) v3.1 Appendix M, August 2007. Tool descriptions were taken from the [Directory of Design Support Methods](#) and in some cases from tool web sites. Photography was provided by the Air Force.

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HSI in Acquisition

Integrating Human Concerns into Life Cycle Systems Engineering



Air Force Human Systems Integration Office

Disclaimer: This product contains references to existing and emerging tools currently available and/or in use in Government, academia, and industry. The tools listed are illustrative of what can be used to perform the identified activities and are not exhaustive due to the volume of tools available. The Air Force Human Systems Integration Office, the Air Force, and the Department of Defense do not endorse any specific contractor or commercial product.

Executive Summary

Human Systems Integration (HSI) encompasses the interdisciplinary technical and management processes for integrating human considerations within and across all system elements; an essential enabler to systems engineering practice. HSI processes facilitate trade-offs among human-centric domains without replacing individual domain activities, responsibilities, or reporting channels. The human-centered domains with recognized application to HSI include: Manpower, Personnel, Training, Human Factors Engineering, Survivability, Environment, Safety, Occupational Health, and Habitability.

The goal of HSI is to maximize total system performance, understanding that the human element is an integral part of systems, while minimizing total ownership costs. To be effective, HSI must be conducted as a fundamental part of the overall systems engineering activities within the Air Force Integrated Defense Acquisition, Technology, and Logistics Life Cycle Management System. HSI activities will focus on overall system performance and also on the design and integration of many subsystems, thus making HSI a critical part of the design process.

This guide assumes a basic understanding of DoD Systems Engineering (SE), HSI principles and practices, and acquisition acronyms and terminology. It was developed to depict when HSI activities should be performed to influence system design throughout the SE process. Its purpose is to facilitate domain and systems engineering integration on HSI issues.

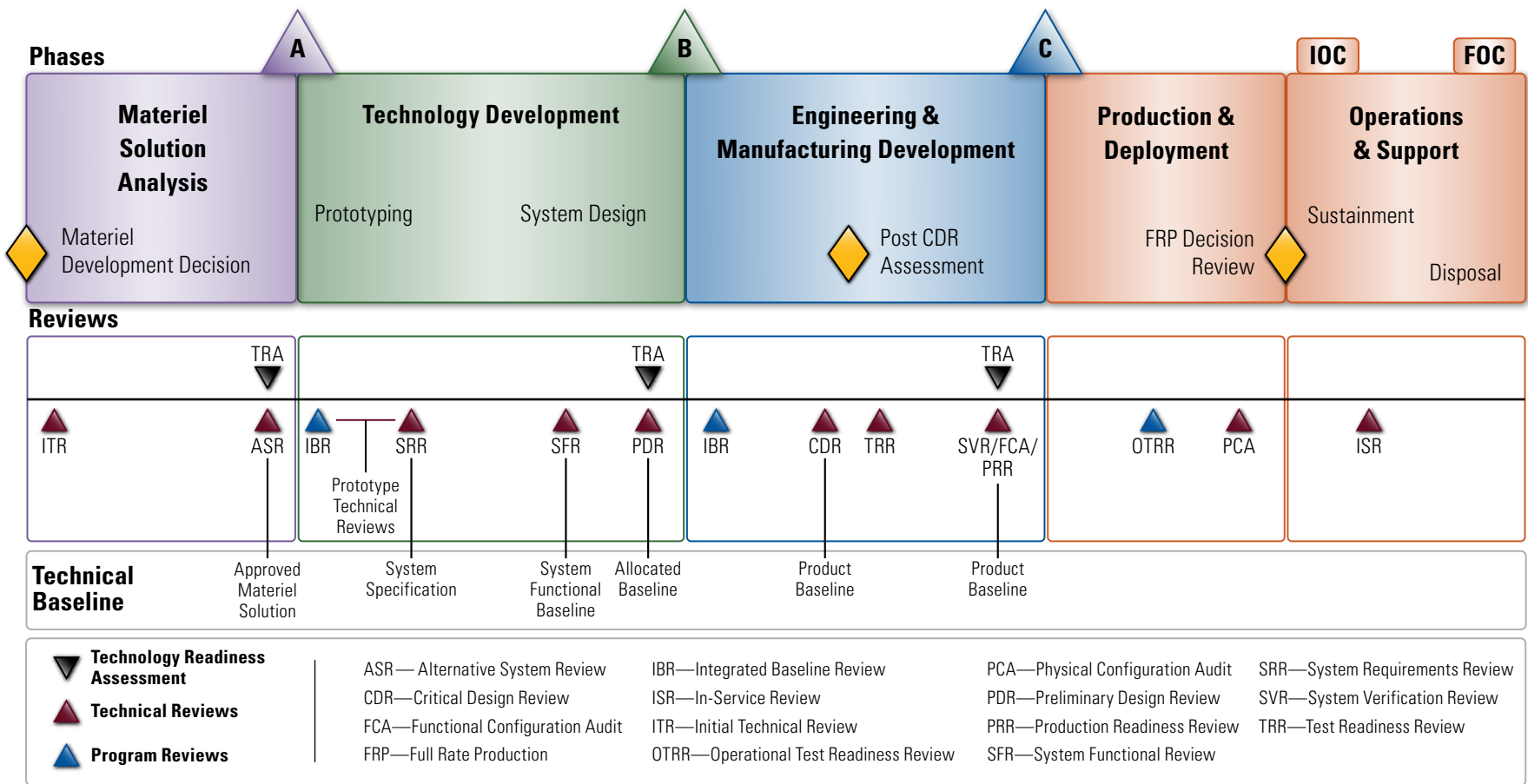
Relevant tasks, tools, and references for HSI and each of the HSI process domains are identified and aligned with existing SE processes and reviews for each acquisition phase. Many of the tasks identified are notional best practices and not all tasks would be performed with every acquisition program.

Three versions of this guide have been produced. This version is organized by acquisition phase. Another version organized by domain is also available as well as a separate, shorter management version which focuses solely on HSI activities. Copies of the other versions can be obtained by contacting [AFHSIO](#).



Materiel Solution Analysis Phase	i	Operations and Support Phase	G
Technology Development Phase	FG	Acronyms	HG
Engineering & Manufacturing Development Phase	Fi	Glossary	Hi
Production & Deployment Phase	G	Tools	H

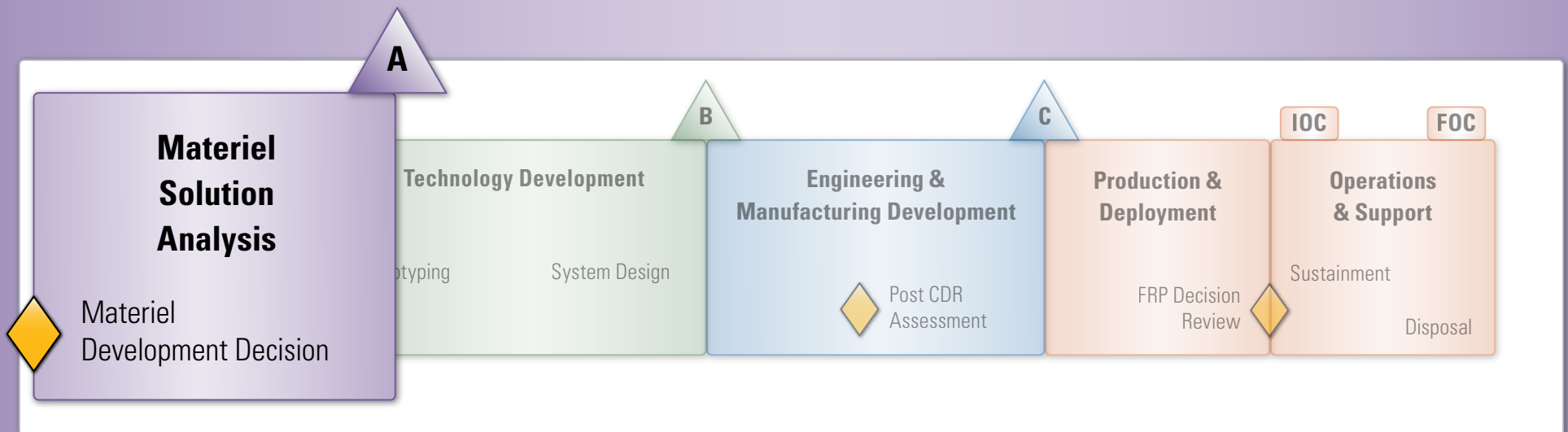
Acquisition Life Cycle and Systems Engineering Technical Review Timing



Human Systems Integration



Human Systems Integration (HSI)—Encompasses the interdisciplinary technical and management processes for integrating human considerations within and across all system elements; an essential enabler to systems engineering practice. The HSI processes facilitate trade-offs among the human-centric domains without replacing individual domain activities, responsibilities, or reporting channels. The human-centered domains with recognized application to HSI include: Manpower, Personnel, Training, Human Factors Engineering, Survivability, Environment, Safety, Occupational Health, and Habitability.



Materiel Solution Analysis—The purpose of this phase is to assess potential materiel solutions. The Materiel Solution Analysis Phase begins with the Materiel Development Decision review which is the formal entry point into the acquisition process. The lead DoD Component(s) prepare an AoA study plan to assess preliminary materiel solutions, identify key technologies, and estimate life-cycle costs. The Materiel Solution Analysis Phase ends when the AoA has been completed, materiel solution options for the capability need identified in the approved ICD have been recommended by the lead DoD Component conducting the AoA, and the phase-specific entrance criteria for the initial review milestone have been satisfied. ([DODI 5000.02](#))

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Materiel Solution Analysis Phase

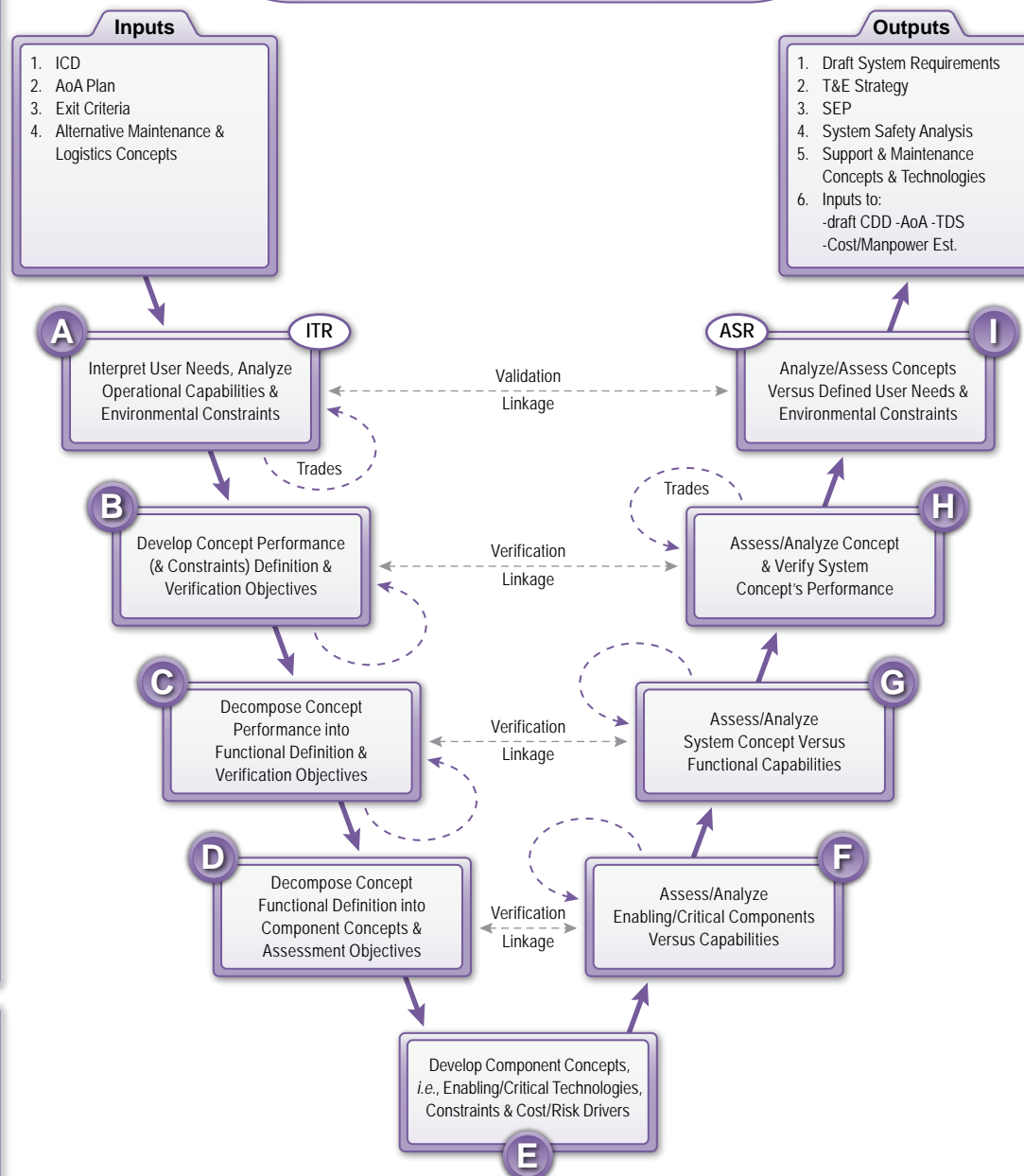
Human Systems Integration

Activities for Each Input:

- 1.0 Review available Concept of Operations (CONOPS) and other available data
- 1.1 Select and review [Baseline Comparison System\(s\) \(BCS\)](#) documentation
- 1.2 Assess potential [HSI](#) domain effects
- 1.3 Ensure human constraints are included
- 1.4 Ensure domain points of contact (POCs) are identified
- 2.0 Set [HSI](#) conditions and constraints for consideration in [Analysis of Alternatives \(AoA\)](#)
- 2.1 Collect domain inputs for each alternative
- 2.2 Define trade space and risk associated with each of the domains
- 3.0 Identify, compile, and track domain exit criteria
- 4.0 Set [HSI](#) conditions and constraints for consideration in concepts
- 4.1 Collect domain inputs for each concept
- 4.2 Define trade space and risk associated with each domain and provide inputs for each concept

References:

- [DODI 5000.02](#) & [DODD 5000.01](#)
- [Defense Acquisition Guidebook \(DAG\)](#)
- [CJCSI 3170.01](#)
- [AFPD 63-1/AFPD 20-1](#)
- [AFI 63-101](#) & [AFI 63-1101](#)
- [AFI 63-1201](#)
- Domain-specific policies



Activities for Each Output:

- 1.0 Collect domain requirements inputs
- 1.1 Ensure draft system requirements include human constraints
- 2.0 Determine which [HSI](#) domains can be tested
- 2.1 Provide domain inputs as applicable
- 3.0 Write draft [HSI](#) Plan
- 4.0 Ensure each domain reviews the Environment, Safety and Occupational Health (ESOH) hazard and risk analysis for each system [e.g., the Preliminary Hazard List (PHL)]
- 4.1 Collect domain impacts and costs
- 4.2 Provide domain trade-off impacts
- 5.0 Summarize domain trade-off inputs
- 5.1 Provide consolidated domain inputs
- 6.0 Provide [HSI](#) and domain inputs as applicable

Tools:

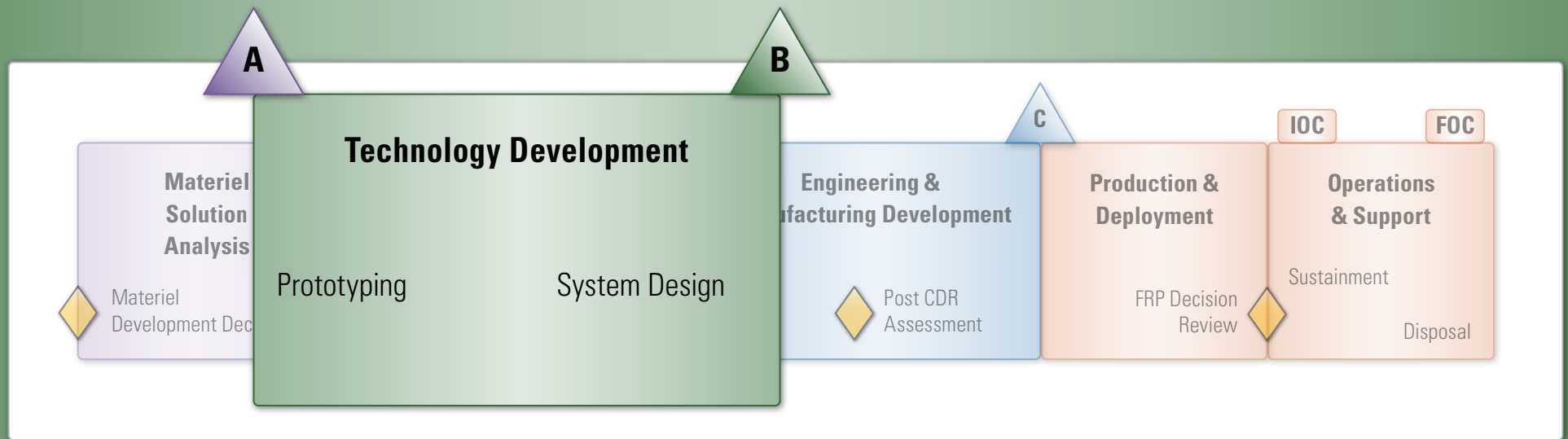
- [CATIA](#)
- [HSI Requirements Guide](#)
- [IMPRINT](#)

The numbers in the Activities boxes correspond to the numbers in the Inputs and Outputs boxes.

Materiel Solution Analysis: Human Systems Integration

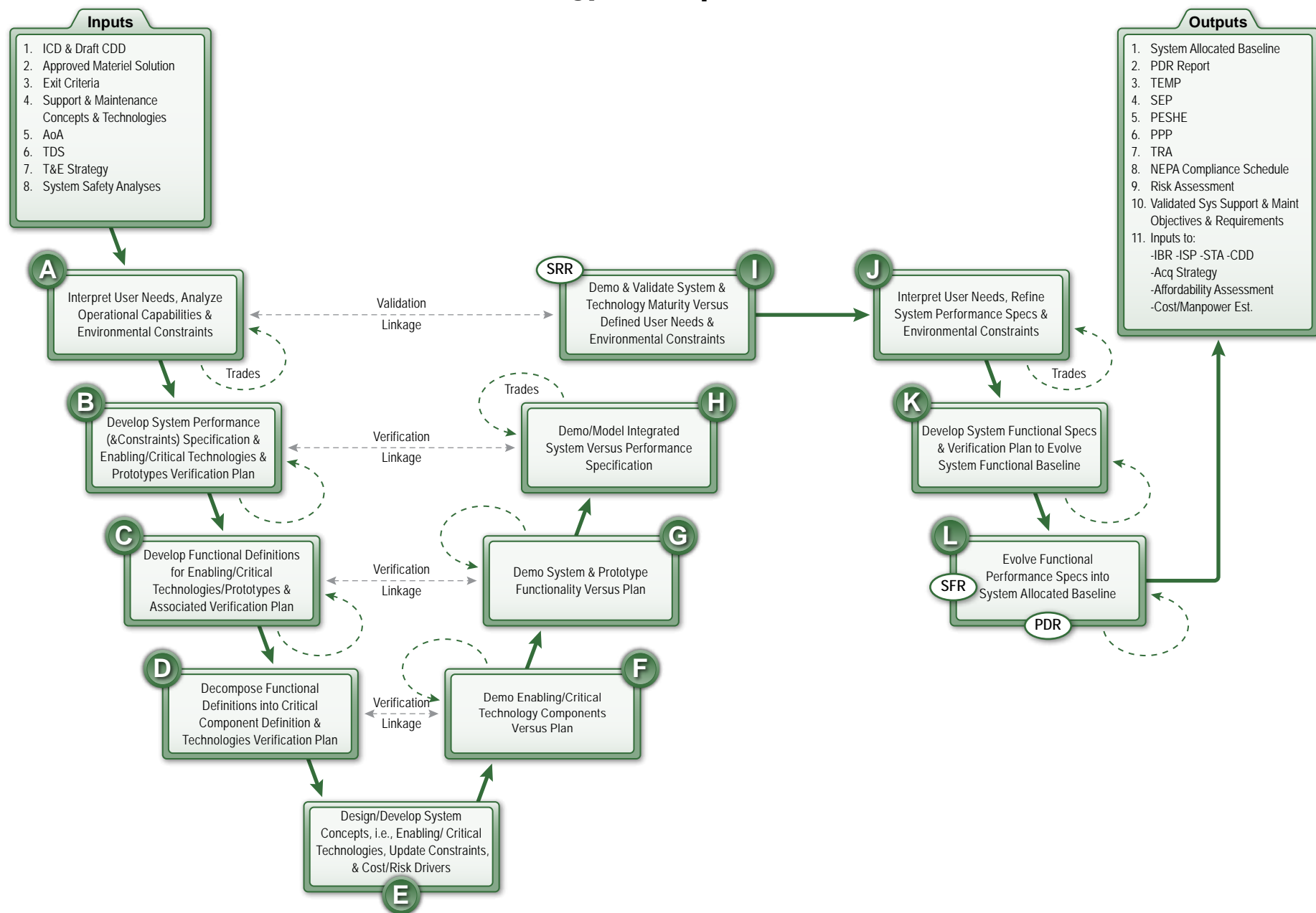
- A**
 - Assess and identify applicable [HSI](#) limitations pertaining to environmental issues such as system threats, usage environment, support environment, doctrine, and operational concepts
 - Assess and identify applicable [HSI](#) limitations pertaining to resources such as the industrial base, notional available development, operation and support budgets, and required date for system fielding
 - Assess and identify applicable [HSI](#) limitations on the technology base to be used for concept maturation
 - Review applicable [HSI](#) limitations in statutory and regulatory documents such as the Federal Acquisition Regulation, the DoD 5000-series, [CJCSM/I](#) guidance, *etc.*
 - Ensure all [HSI](#) drivers of the concept definition are completely captured and managed as an integral human-centered system
- B**
 - Analyze and assess trade space and [HSI](#) risks for each alternative concept
 - Define and relate human performance to capability needs and draft [CONOPS](#)
 - Define test requirements needed to evaluate the ability of the matured system concept(s) to meet requirements of verification planning
 - Assess and document derived [HSI](#) requirements at the system performance level
- C**
 - Translate concept-level [HSI](#) criteria (*e.g.*, applicable [HSI](#) impacts, human performance limitations, domain-specific risks, tactical system, support system, training system, *etc.*) into functional requirements
 - Analyze and assess trade space and [HSI](#) risks against desired functional performance in accordance with draft [CONOPS](#)
 - Enable verification planning for test and evaluation of matured concept functionality as defined in system function allocation
- D**
 - Analyze allocation of concept functions into component concepts and assessment objectives OR apply identified [HSI](#) constraints to analyze and define concept component design requirements
 - Test and evaluate [HSI](#) component-level requirements through verification planning
- E**
 - Ensure that [HSI](#) is adequately addressed in analyses, modeling and simulation, demonstrations, *etc.*
 - Review historical information (*e.g.*, successes, mishaps, lessons learned, poor human performance, *etc.*)
- F**
 - Assess [HSI](#) impacts when rating component concept alternatives
 - Review results of hardware and software modeling, simulations, demonstrations, and prototypes to verify the satisfaction of component-level [HSI](#) requirements
- G**
 - Ensure that [HSI](#) attributes are integrated to support overall capability
 - Assess [HSI](#) functional-level impacts of rating concept alternatives
 - Review results of hardware and software modeling, simulations, demonstrations, and prototypes to verify that functional-level [HSI](#) requirements have been satisfied
- H**
 - Assess each system concept against identified [HSI](#) criteria and requirements
 - Document critical [HSI](#) risks, mitigations, and potential trade-offs for each concept alternative
 - Rate concept alternatives at this level to identify critical [HSI](#) risks and mitigation control measures
- I**
 - Ensure that [HSI](#) considerations are included in the identification of advantages/disadvantages for each approach
 - Ensure that enabling technologies address [HSI](#) considerations
- ITR**
 - Review Cost Analysis Requirements Description (CARD)-like documents to confirm that [HSI](#) has been included in the system overview, risk and system operation concept
 - Verify that [HSI](#) inputs are included throughout the program's cost estimate
 - Verify that [HSI](#) domain requirements are included and presented in sufficient detail to support a valid program cost estimate
 - Provide [HSI](#) inputs to reflect the chosen materiel solution approach
 - Provide [HSI](#) assumptions, risks, and cost drivers
- ASR**
 - Review [AoA](#) and evaluate multiple alternatives for the system
 - Verify that system requirements are consistent with user needs and applicable [HSI](#) domain standards
 - Provide [HSI](#) inputs and risks for alternative materiel solutions that have been identified
- Trades**
 - Participate in [AoA](#) to ensure that [HSI](#) considerations have been addressed in the assessment of advantages and disadvantages
 - Participate in trade studies to identify potential [HSI](#) hazards and risks, to ensure that [HSI](#) criteria are included in this phase

The letters on this page correspond with the letters on the previous page and are associated with the respective SE step boxes.



Technology Development—The purpose of this phase is to reduce technology risk, determine and mature the appropriate set of technologies to be integrated into a full system, and to demonstrate critical technology elements on prototypes. Technology Development is a continuous technology discovery and development process reflecting close collaboration between the [S&T](#) community, the user, and the system developer. It is an iterative process designed to assess the viability of technologies while simultaneously refining user requirements. ([DODI 5000.02](#))

Technology Development Phase



Technology Development Phase (Inputs)

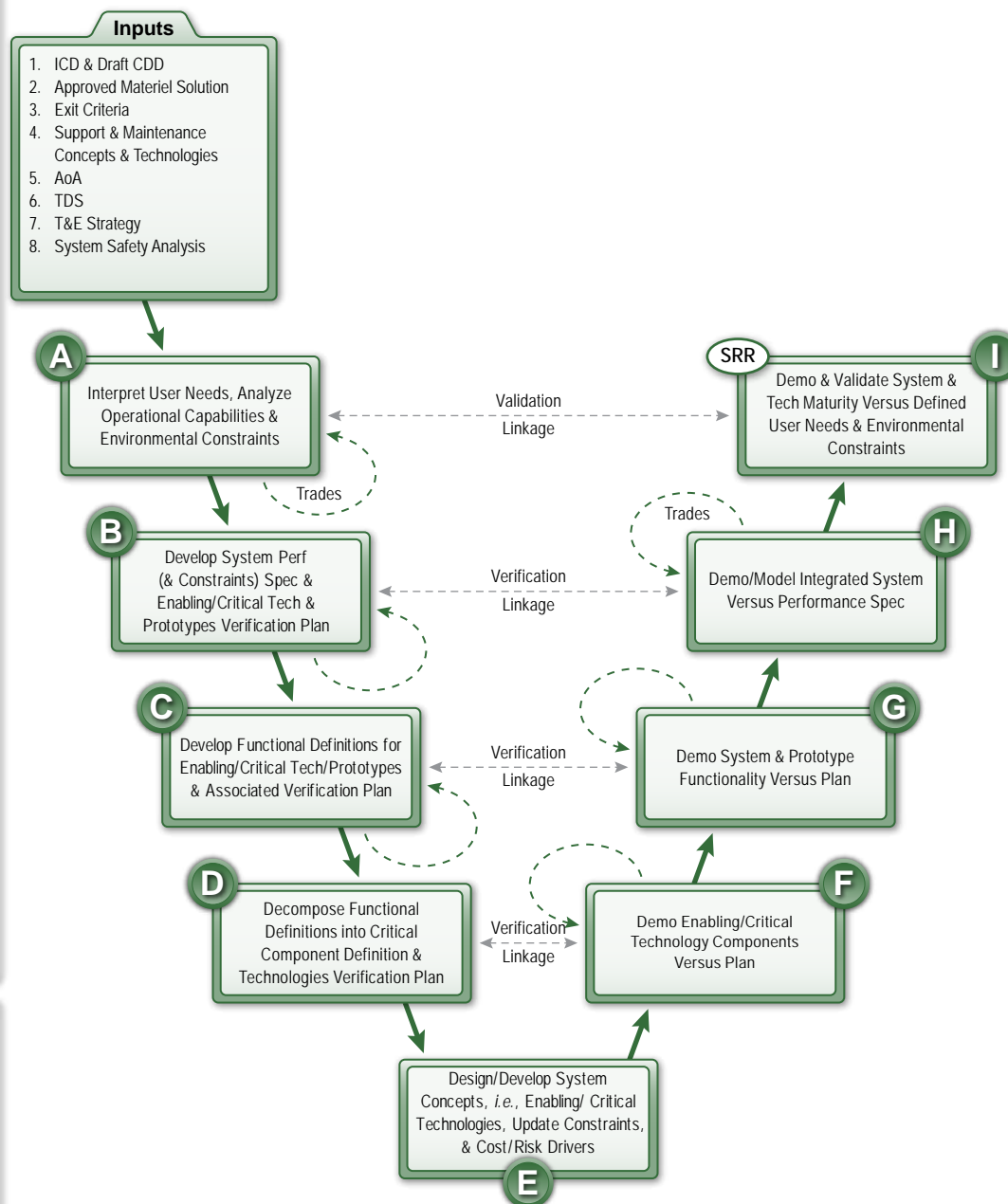
Human Systems Integration

Activities for Each Input:

- 1.0 Update [HSI](#) domain effects
- 1.1 Review and update human constraints
- 2.0 Identify trade-off opportunities among domains
- 2.1 Evaluate requirements against concepts
- 2.2 Assess domain risks and impacts
- 3.0 Identify the key risks
- 3.1 Develop [ESOH](#) hazard and risk analysis (e.g., [PHL](#))
- 4.0 Assess [HSI](#) domain inputs for maintenance and support strategies
- 5.0 Identify associated risks for each alternative
- 5.1 Provide domain inputs for each alternative
- 5.2 Identify alternatives' strengths and weaknesses based on [HSI](#) domain trade-offs
- 6.0 Review domain inputs for proposed capabilities
- 6.1 Identify candidate [HSI](#) technologies for maturation based on Total Risk Assessment (TRA)
- 7.0 Prioritize [HSI](#) domain requirements for the chosen materiel solution
- 7.1 Distinguish risk controls and mitigation technologies
- 7.2 Verify process for [HSI](#) domain requirements verification
- 8.0 Develop safety analysis for each concept
- 8.1 Coordinate within domains to identify hazards

References:

- [DODI 5000.02](#) & [DODD 5000.01](#)
- [DAG](#)
- [CJCSI 3170.01](#)
- [AFPD 63-1/AFPD 20-1](#)
- [AFI 63-101](#) & [AFI 63-1101](#)
- [AFI 63-1201](#)
- Domain-specific policies



The numbers in the Activities boxes correspond to the numbers in the Inputs and Outputs boxes.

Tools:

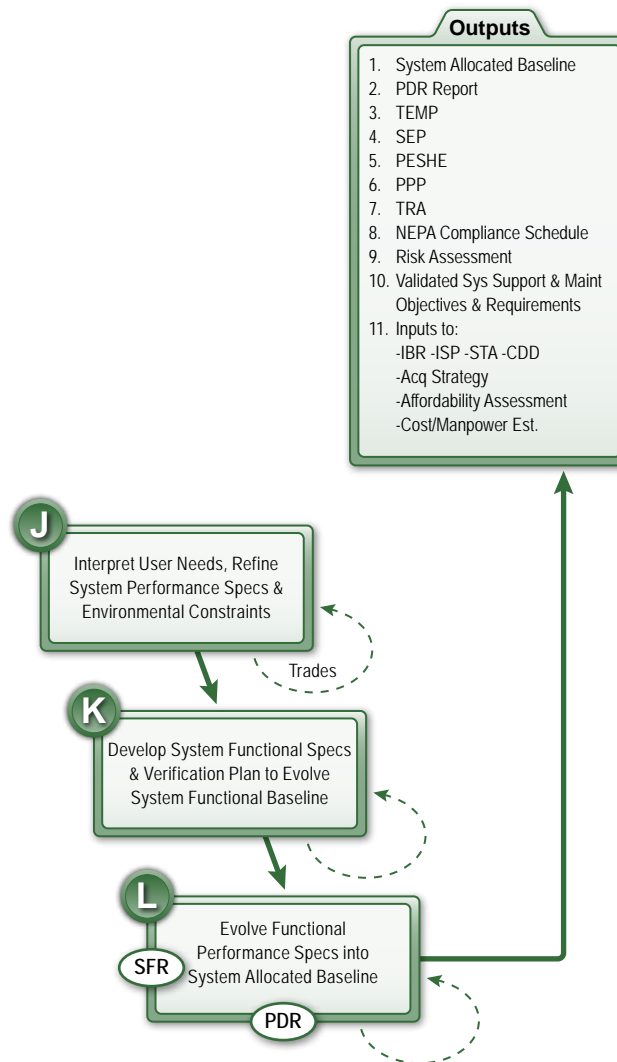
- [IMPRINT](#)
- [CATIA](#)
- [IPME](#)

Technology Development Phase (Inputs): Human Systems Integration

- A**
 - Identify critical [HSI](#) technology needs
 - Assess [HSI](#) domain-specific technology maturity to minimize impact on [HSI](#) domains
- B**
 - Ensure [HSI](#) criteria are traceable back to defined system capabilities and constraints
 - Identify [HSI](#) requirements in any system or subsystem performance specification, solicitation, contract, and evaluation criteria
 - Define [HSI](#) test requirements for identified technologies
- C**
 - Define [HSI](#) criteria for weapon system, support, equipment, and training systems
 - Assess [HSI](#) impacts from technology trade-offs or refinements
 - Define [HSI](#) test requirements for identified technologies
- D**
 - Update system [HSI](#) criteria
 - Assess [HSI](#) impacts on hardware and software elements (physical interfaces, functional interfaces, standards, and existing technologies)
 - Understand [HSI](#) impacts for system-of-systems technology
 - Define [HSI](#) testing and validation requirements for critical system components
- E**
 - Address [HSI](#) risk areas within modeling and simulation demonstrations and analyses
 - Identify and evaluate [HSI](#) constraints and risks associated with the overall system
 - Revise [HSI](#) cost and risk drivers based on technology testing and validation
- F**
 - Integrate evaluations of critical technologies across all functional areas
 - Validate technology components against system component [HSI](#) requirements
 - Participate in and evaluate demonstrations for [HSI](#) impacts with new technology components
- G**
 - Evaluate critical technologies from an [HSI](#) perspective
 - Review demonstration results for [HSI](#)-related constraints, risks, and opportunities
 - Assess [HSI](#) impacts associated with trade-offs or component refinements
- H**
 - Evaluate critical technologies from an [HSI](#) perspective
 - Ensure [HSI](#) is properly reflected in modeling and simulation engineering development models
 - Review demonstration results for [HSI](#)-related constraints, risks, and opportunities
 - Assess [HSI](#) impacts associated with accepted technology risks and system capabilities
- I**
 - Ensure applicable [HSI](#) elements are embedded in the System Performance Specification and associated system development plans
- SRR**
 - Validate [HSI](#) criteria against user requirements
 - Ensure [HSI](#) requirements have been included in the Systems Performance Specification
 - Ensure all [HSI](#) performance requirements that affect system requirements derived from the [Capability Development Document \(CDD\)](#) are testable and defined in the system functional baseline
 - Ensure that [HSI](#) risks are included in the comprehensive risk assessment
- Trades**
 - Participate in [AoA](#) to ensure that [HSI](#) considerations have been addressed in the assessment of advantages and disadvantages
 - Ensure trade space and risks analyzed include [HSI](#) considerations and are assessed against available technologies

The letters on this page correspond with the letters on the previous page and are associated with the respective SE step boxes.

Technology Development Phase (Outputs) Human Systems Integration



References:

- [DODI 5000.02](#) & [DODD 5000.01](#)
- [DAG](#)
- [CJCSI 3170.01](#)
- [AFPD 63-1/AFPD 20-1](#)
- [AFI 63-101](#) & [AFI 63-1101](#)
- [AFI 63-1201](#)
- Domain-specific policies

Activities for Each Output:

- 1.0 Incorporate domain considerations into baseline parameters
- 1.1 Identify domain performance requirements
- 1.2 Assign requirements to system components
- 2.0 Address all [HSI](#) concerns
- 2.1 Document [HSI](#) issues, concerns, risks, and action items
- 3.0 Provide [HSI](#) inputs for testing
- 3.1 Ensure [HSI](#) risk areas will be tested
- 3.2 Identify preliminary [HSI](#) test techniques
- 4.0 Include [HSI](#) planning
- 4.1 Include [HSI](#) inputs throughout
- 5.0 Include [HSI](#) integration strategy, risks, responsibilities, and hazard tracking process
- 6.0 Provide [HSI](#) inputs as needed
- 7.0 Update risk mitigation technology readiness levels
- 8.0 Review and update checklist items
- 9.0 Reassess [HSI](#) risks
- 9.1 Update [HSI](#) risks and inputs to other technology areas
- 10.0 Provide [HSI](#) inputs to support and maintenance requirements
- 11.0 Participate in compilation of the inputs with [HSI](#)
- 11.1 Provide [HSI](#) requirements and domain inputs as applicable
- 11.2 Update the Manpower Estimate Report (MER)

Tools:

- [IMPRINT](#)
- [CATIA](#)
- [IPME](#)

The numbers in the Activities boxes correspond to the numbers in the Inputs and Outputs boxes.

Technology Development Phase (Outputs): Human Systems Integration

J

- Develop [HSI](#) profile and system boundaries across the life cycle
- Embed [HSI](#) in requirements and acquisition documentation *i.e.*, Initial Capabilities Document (ICD), [CDD](#), [Acquisition Program Baseline \(APB\)](#), Systems Engineering Plan (SEP), Human Systems Integration Plan (HSIP), Test and Evaluation Master Plan (TEMP), [Life Cycle Management Plan \(LCMP\)](#), *etc.*
- Identify, develop, and document [HSI](#)-critical requirements and verify they are included in the requirements tracking system
- Include [ESOH](#) assessment (reference updated [DAG, Chapter 4–Systems Engineering](#))

K

- Conduct [HSI](#) analysis and develop [HSI](#) risk metrics
- Research all subsystem Human-Machine Interface (HMI) and [HSI](#) requirements
- Review all trade studies for [HSI](#) impacts
- Expand [HSI](#) analysis to include functional specifications
- Verify [HSI](#)-critical functional specifications are included in requirements tracking system and in the System Verification Plan
- Verify [National Environmental Policy Act Executive Order \(NEPA/EO\) 12114](#) requirements are being met at proposed testing and training locations
- Provide [HSI](#) updates for demilitarization/disposal planning
- Identify [HSI](#) requirements in system or subsystem solicitations or contracts

L

- Review updated [ESOH](#) hazard and risk analysis for [HSI](#) impacts [*e.g.*, Preliminary Hazard Analysis (PHA), System Hazard Analysis (SHA), Subsystem Hazard Analysis (SSHA), and Operations and Support Hazard Analysis (O&SHA)]
- Review [HSI](#)-derived requirements for component, subsystem, and system to include test requirements
- Provide updated input for demilitarization/disposal planning
- Expand and update [HSI](#) limitations, risks, and attributes as detailed design specifications evolve
- Verify [HSI](#)-critical design specifications are included in requirements tracking system, detailed design specifications, and in [Configuration Item \(CI\)](#) Verification Plan
- Address [HSI](#) in the Preliminary Design Review (PDR)

SFR

- Address [HSI](#) requirements in the system functional baseline and in conjunction with the lower-level performance requirements
- Ensure requirements, metrics, and development efforts associated with [HSI](#) are included in the program documentation and [LCMP](#)
- Ensure system requirements and the functional baseline are sufficiently detailed to enable a reasonable cost estimate

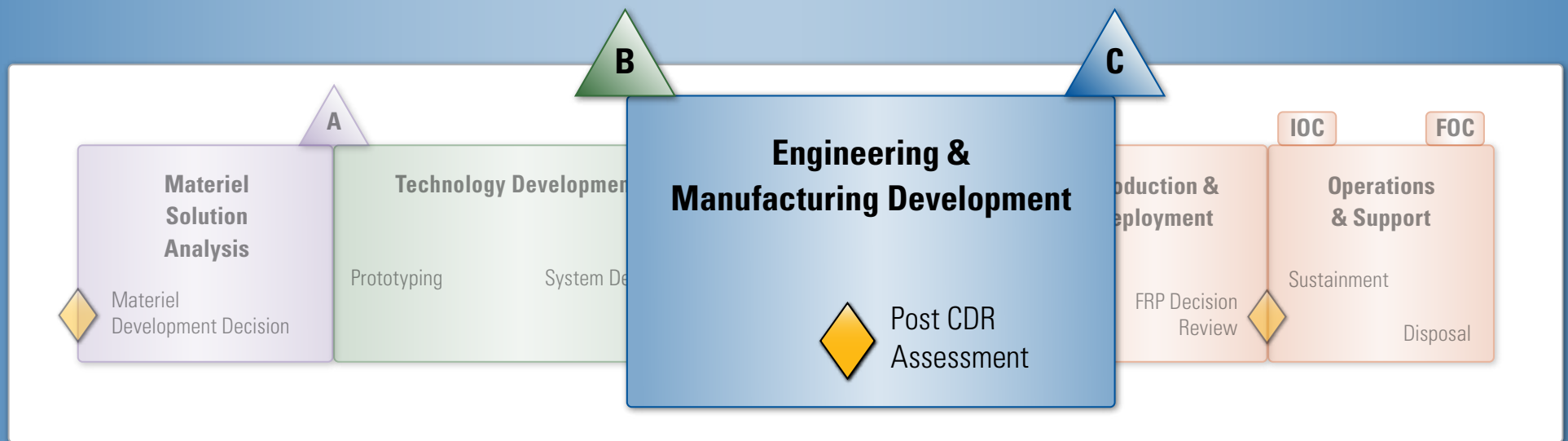
PDR

- Ensure domain-specific performance requirements are included in the preliminary design
- Review subsystem requirements to address [HSI](#) issues
- Ensure [HSI](#) design factors have been reviewed and included where needed in the overall system design
- Ensure [HSI](#) risks are identified and manageable
- Ensure 100% of all safety-critical drawings are complete
- Ensure requirements, metrics, and development efforts associated with [HSI](#) are included in the program documentation and [LCMP](#)
- Evaluate the preliminary design for possible risks, design shortfalls, and undocumented requirements

Trades

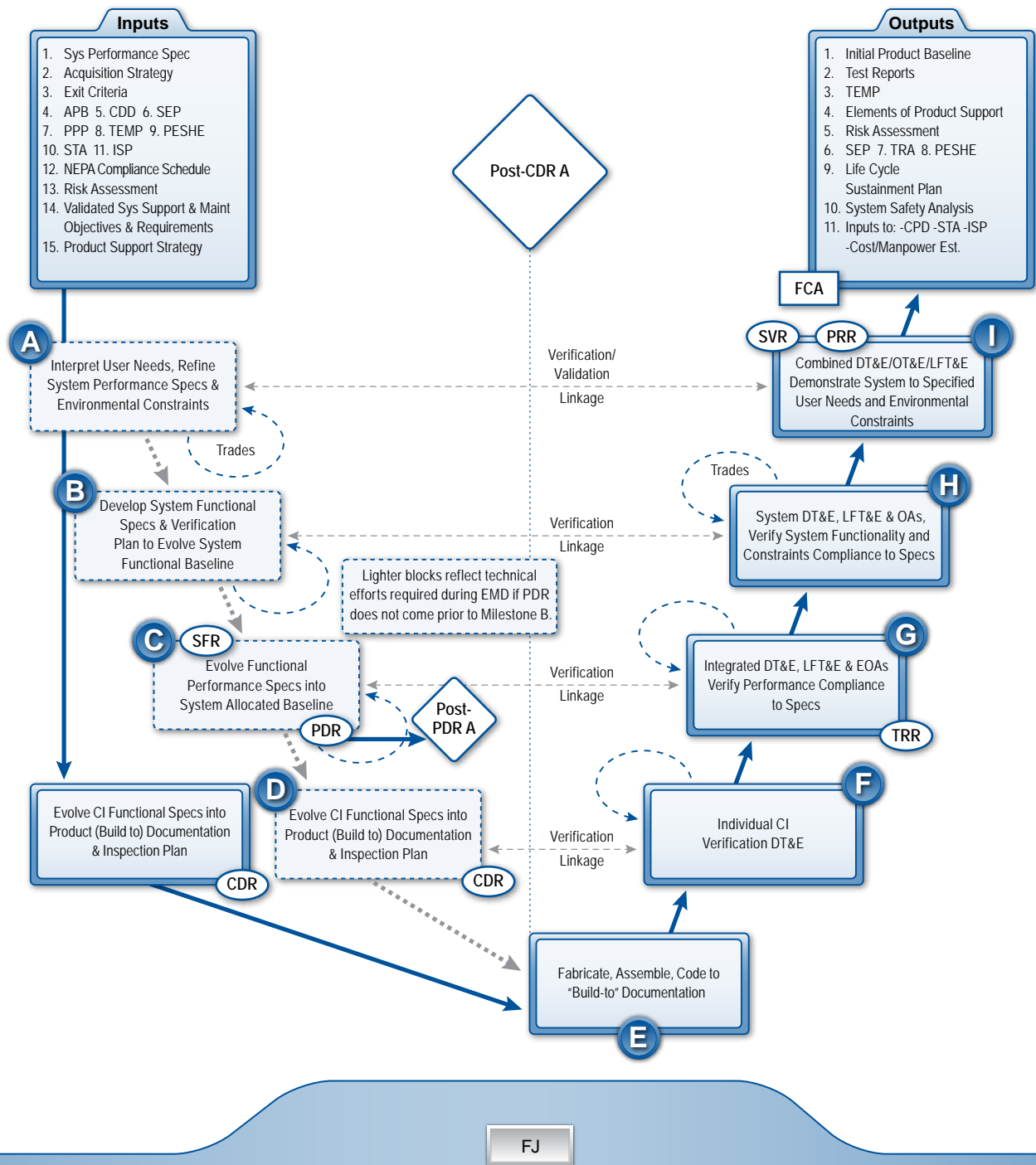
- Conduct trade studies on threshold and objective levels of [HSI](#) requirements as the design matures
- Refine [HSI](#)-related key performance parameter thresholds and objectives with approval of requirements authority
- Participate in [HSI](#)-critical trade studies
- Review results of all trade studies
- Coordinate with other [HSI](#) domains to assess trade-offs within [HSI](#) and determine technology readiness

The letters on this page correspond with the letters on the previous page and are associated with the respective SE step boxes.



Engineering and Manufacturing Development—The purpose of the EMD Phase is to develop a system or an increment of capability; complete full system integration (technology risk reduction occurs during Technology Development); develop an affordable and executable manufacturing process; ensure operational supportability with particular attention to minimizing the logistics footprint; implement human systems integration (HSI); design for producibility; ensure affordability; protect [CPI](#) by implementing appropriate techniques such as anti-tamper; and demonstrate system integration, interoperability, safety, and utility. ([DODI 5000.02](#))

Engineering & Manufacturing Development



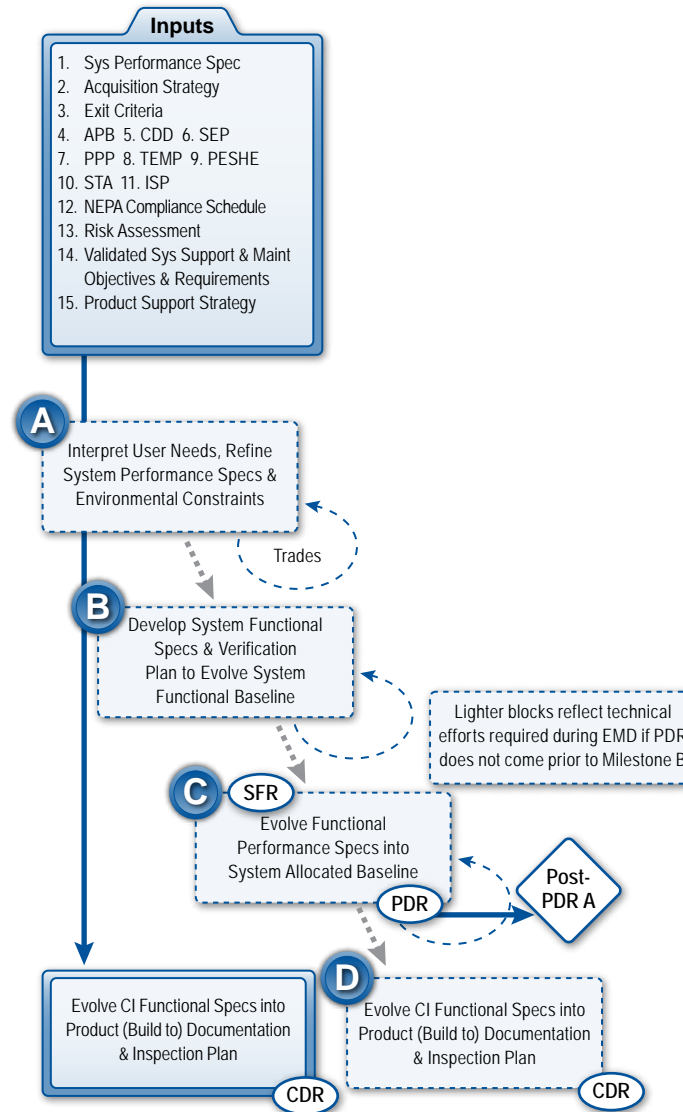
Human Systems Integration

Activities for Each Input:

- 1.0 Update [HSI](#) performance criteria
- 1.1 Ensure domain-specific inputs are included
- 2.0 Provide [HSI](#) inputs as required
- 3.0 Update critical domain-specific risks and mitigation approaches
- 4.0 Verify [HSI](#) criteria are included
- 5.0 Update [HSI](#) inputs
- 6.0 Validate and finalize [HSIP](#)
- 6.1 Include [HSI](#) domain inputs
- 7.0 Provide [HSI](#) inputs as required
- 8.0 Assess [HSI](#) risk areas
- 8.1 Review modeling and simulation efforts and results
- 8.2 Develop and document Live Fire Test and Evaluation (LFT&E) strategy
- 9.0 Coordinate with [ESOH](#) Subject Matter Experts (SMEs) to verify [HSI](#) consideration
- 9.1 Review the Programmatic Environment, Safety, and Occupational Health Evaluation (PESHE) and ensure it includes [HSI](#) integration strategy, risks, responsibilities, and hazard tracking process
- 10.0 Verify [HSI](#) content if required
- 11.0 Verify [HSI](#) content if required
- 12.0 Review [NEPA](#) schedule checklist items for [HSI](#) inputs as applicable
- 13.0 Update [HSI](#) risks based on new/recent tests and analysis
- 14.0 Provide consolidated [HSI](#) inputs to the support and maintenance requirements and associated plans
- 15.0 Provide [HSI](#) inputs as required

References:

- [DODI 5000.02](#) & [DODD 5000.01](#)
- [DAG](#)
- [CJCSI 3170.01](#)
- [AFPD 63-1/AFPD 20-1](#)
- [AFI 63-101](#) & [AFI 63-1101](#)
- [AFI 63-1201](#)
- Domain-specific policies



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Tools:

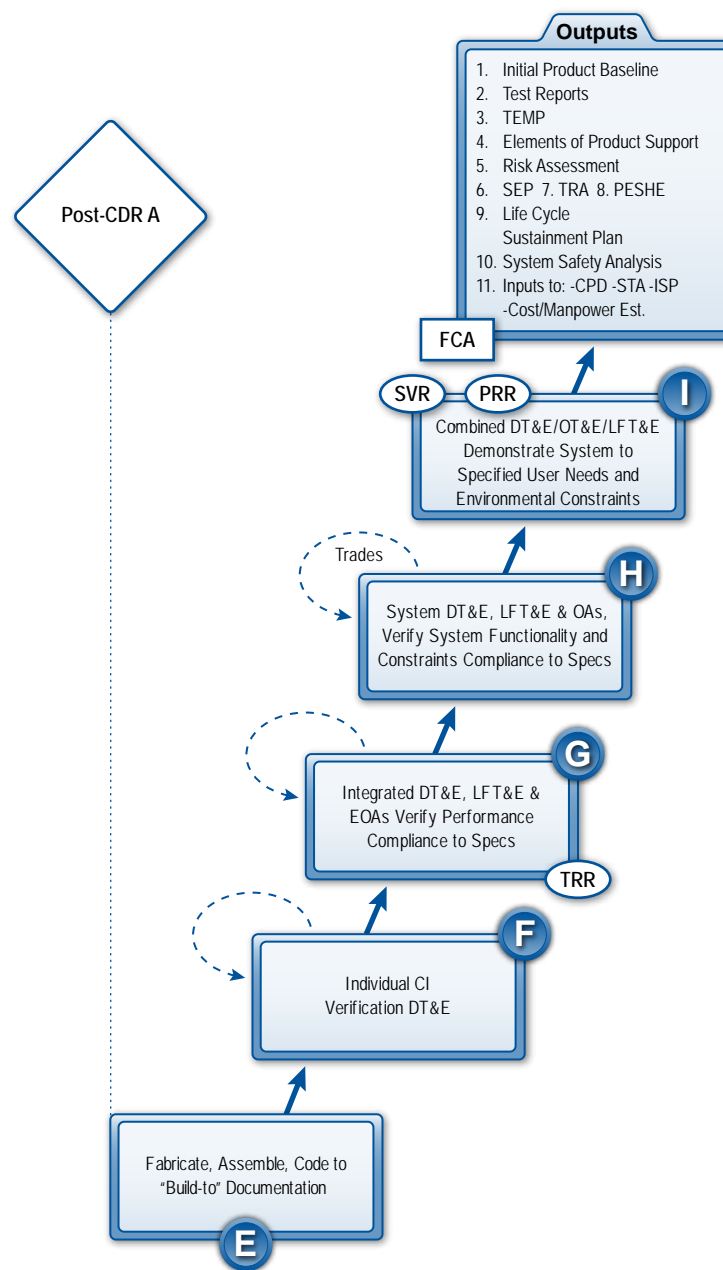
- [IMPRINT](#)
- [CATIA](#)
- [ATB Model](#)
- [IPME](#)

Engineering and Manufacturing Development (Inputs): Human Systems Integration

- A**
- Develop [HSI](#) profile and system boundaries across the life cycle
 - Embed [HSI](#) in requirements and acquisition documentation *i.e.*, [ICD](#), [CDD](#), [APB](#), [SEP](#), [HSIP](#), [TEMP](#), [LCMP](#)
 - Identify and/or develop [HSI](#)-critical requirements and verify they are included in the requirements tracking system
 - Include [ESOH](#) assessment (reference updated [DAG, Chapter 4–Systems Engineering](#))
- B**
- Initiate development of [HSI](#) analysis and risk metrics
 - Review and understand all subsystem [HMI](#) and [HSI](#) requirements
 - Review all trade studies for [HSI](#) impacts
 - Expand [HSI](#) analysis to include functional specifications
 - Verify [HSI](#)-critical functional specifications are included in the requirements tracking system and in the System Verification Plan
 - Verify [NEPA/EO 12114](#) requirements are being met at proposed testing and training locations
 - Provide updated input for demilitarization/disposal planning
- C**
- Review updated system safety and [ESOH](#) hazard and risk analysis for [HSI](#) impacts (*e.g.*, [PHA](#), [SHA](#), [SSHA](#), and [O&SHA](#))
 - Review [HSI](#)-derived requirements for component, subsystem, and system to include test requirements
 - Provide updated input for demilitarization/disposal planning
 - Expand and update [HSI](#) limitations, risks, and attributes as detailed design specifications evolve
 - Verify [HSI](#)-critical design specifications are included in requirements tracking system, detailed design specifications, and in the [CI](#) Verification Plan
 - Ensure [HSI](#) is addressed as part of the overall [PDR](#)
- D**
- Review [ESOH](#) hazard and risk analysis for [HSI](#) impacts (*e.g.*, [SSHA](#), [SHA](#), and [O&SHA](#))
 - Update [HSI](#)-derived requirements for component, subsystem, and system to include test and inspection requirements
 - Identify [HSI](#)-critical processes for product baseline build-to documentation and software code-to documentation
 - Include system [HSI](#)-critical processes and components in inspection plan
 - Participate in component design selections
 - Review Level of Repair Analysis and Maintenance Task Analysis for [HSI](#) impacts
 - Verify system [HSI](#)-critical design specifications are included in the requirements tracking system and detailed design specifications as necessary
- SFR**
- Ensure [HSI](#) requirements are addressed in the system functional baseline in conjunction with the lower-level performance requirements
 - Incorporate [HSI](#) in system and software assessments
 - Ensure requirements, metrics, and development efforts associated with [HSI](#) are included in the program documentation and [LCMP](#)
 - Ensure system requirements and the functional baseline are sufficiently detailed to enable a reasonable cost estimate
- PDR**
- Ensure domain performance requirements are included in the preliminary design
 - Review subsystem requirements to address [HSI](#) issues from all functional areas
 - Ensure [HSI](#) design factors have been reviewed and included where needed in the overall system design
 - Ensure [HSI](#) risks are identified and manageable
 - Ensure 100% of all safety-critical drawings are complete.
 - Ensure requirements, metrics, and development efforts associated with [HSI](#) are included in the program documentation and [LCMP](#)
 - Evaluate the preliminary design for possible risks, design shortfalls and undocumented requirements
- CDR**
- Update [HSI](#) inputs in the risk assessment
 - Review [CDD](#) requirements to ensure [HSI](#) concerns are considered
 - Ensure [HSI](#) risks are identified and manageable
 - Ensure requirements, metrics, and development efforts associated with [HSI](#) are included in the program documentation and [LCMP](#)
 - Ensure hardware design and software product specifications have adequately addressed all [HSI](#) risks
- Trades**
- Participate in [HSI](#)-critical trade studies and review results of all trade studies
 - Ensure as the design is finalized, [HSI](#) considerations that affect the component level of the system are part of the decision making and trade studies that occur at this level of design
 - Coordinate with other [HSI](#) domains to assess trade-offs within [HSI](#) and determine technology readiness
 - Coordinate with systems engineers to provide inputs to trade-offs that affect system and subsystem [HSI](#) requirements
- Post-PDR A**
- Ensure open [HSI](#) issues and risks are documented in the [PDR](#) assessment report
 - Review documentation for domain-specific requirements, analysis, decisions, and taskings

The letters on this page correspond with the letters on the previous page and are associated with the respective SE step boxes.

Human Systems Integration



References:

- [DODI 5000.02](#) & [DODD 5000.01](#)
- [DAG](#)
- [CJCSI 3170.01](#)
- [AFPD 63-1/AFPD 20-1](#)
- [AFI 63-101](#) & [AFI 63-1101](#)
- [AFI 63-1201](#)
- Domain-specific policies

Activities for Each Output:

- 1.0 Update domain considerations into baseline parameters and reassess domain performance requirements
- 1.2 Integrate subsystem and component requirements
- 2.0 Identify **HSI** concerns in modeling and simulation outputs, mock-up tests, and first article testing
- 3.0 Review and update for **HSI** issues
- 4.0 Identify **HSI** aspects of maintenance and logistics
- 5.0 Document residual risks and **HSI** risk acceptance decisions
- 5.1 Review domain-specific incidents and mishaps that are **HSI**-related
- 6.0 Update **HSIP** with **HSI**-related concerns from technical reviews
- 6.1 Update strategy to reflect **HSI** risks and control measures
- 7.0 Update **HSI** technology readiness levels from risk considerations
- 8.0 Identify **ESOH** risks and strategy for integration into **SEP** and **HSIP**
- 8.1 Review identified gaps with **ESOH POCs**
- 9.0 Update **HSI** inputs to maintenance and logistics planning
- 10.0 Review System Safety Analysis for accuracy and completeness
- 10.1 Review safety analysis data for **HSI** opportunities
- 11.0 Provide **HSI** inputs as required
- 11.1 Update the **MER** with **HSI**-relevant content

Tools:

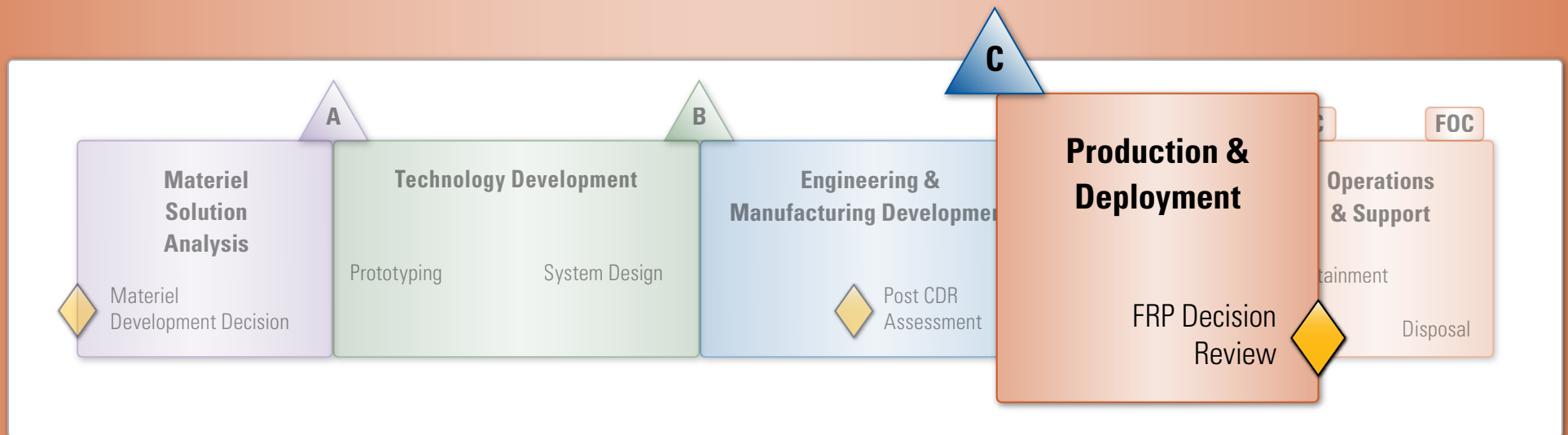
- [IMPRINT](#)
- [CATIA](#)
- [ATB Model](#)
- [IPME](#)

The numbers in the Activities boxes correspond to the numbers in the Inputs and Outputs boxes.

Engineering and Manufacturing Development (Outputs): Human Systems Integration

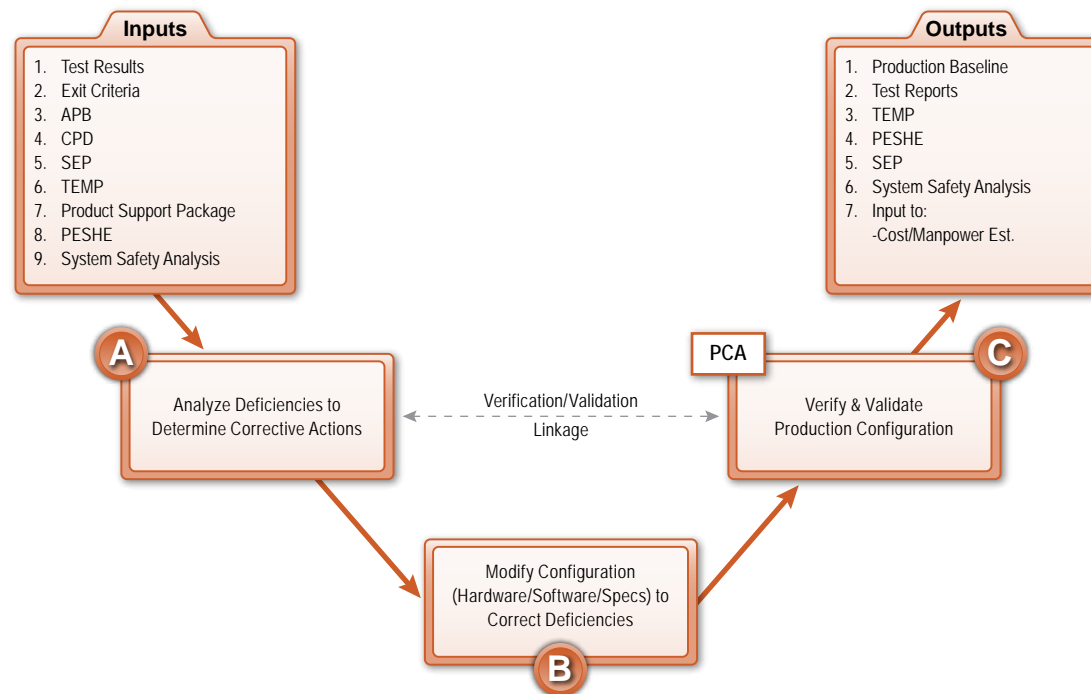
- E**
 - Evaluate process and design changes as necessary
 - Review and recommend **HSI** updates to the **TEMP**
 - Ensure **CI** verification Developmental Test and Evaluation (DT&E) procedures include **HSI** requirements and verification testing
 - Initiate **HSI** risk acceptance reviews and documentation as appropriate
- F**
 - Update status information on **HSI** risks and impacts
 - Verify integrated **DT&E**, **LFT&E**, and Early Operational Assessment (EOA) procedures include appropriate **HSI** tests and evaluations
 - Recommend **HSI** risk mitigation control measures based on **DT&E** test results as appropriate
 - Initiate **HSI** risk acceptance reviews and documentation as appropriate
 - Ensure **NEPA/EO 12114** compliance is completed prior to testing
- G**
 - Ensure tests are conducted that address **HSI** and all test results are reviewed for hazard control effectiveness
 - Update **HSI** impacts and risks based upon configuration changes
 - Provide updated **HSI** input for demilitarization/disposal planning
 - Verify system **DT&E**, **LFT&E** and **EOA** procedures include **HSI**-appropriate tests
 - Recommend **HSI** risk mitigation measures based on test results
 - Provide **HSI** risk review and acceptance for upcoming test activities, as appropriate
 - Verify that **HSI** test results support specification requirements
- H**
 - Ensure **NEPA/EO 12114** compliance is completed prior to testing
 - Ensure test results mitigated **HSI**-relevant challenges
 - Update **HSI** status and analyses based upon configuration changes
 - Verify the combined **DT&E**, **LFT&E** and **EOA** procedures include appropriate **HSI** tests derived from system **HSI** analyses and reviews
 - Recommend **HSI** risk mitigation measures as necessary
 - Provide **HSI** risk review and acceptance for upcoming test activities as appropriate
 - Ensure **HSI** issues identified during testing are resolved
- I**
 - Ensure **NEPA/EO 12114** compliance is completed prior to testing
 - Ensure test results mitigated **HSI**-relevant challenges
 - Review operational supportability and interoperability certifications for **HSI** sufficiency
 - Identify and characterize any residual **HSI** risks
 - Update **HSI** status and analyses based upon configuration changes
 - Recommend **HSI** risk mitigation measures, as necessary
- TRR**
 - Ensure tests are planned to address identified **HSI** requirements
 - Ensure test procedures and planning are complete and compliant for **HSI**
 - Verify that identified **HSI** risk levels are acceptable to the program leadership
 - Ensure operations and support **HSI** risks are fully documented and made available to testers
- SVR**
 - Ensure system functionality is assessed and determine if it meets **HSI** requirements documented in the functional baseline
 - Ensure adequate **HSI** metrics are in place
 - Ensure **HSI** risks are identified and manageable
 - Review manufacturing processes to ensure the manufacturer has addressed **HSI** issues, focusing on environment, safety, packaging, and transportation
 - Reassess production readiness in the event of significant manufacturing process changes (*i.e.*, new locations or subcontractors)
- PRR**
 - Ensure **HSI** risks are identified and manageable
 - Ensure changes made during Engineering and Manufacturing Development do not degrade **HSI** in either the materials or manufacturing processes
- FCA**
 - Confirm the **HSI** performance requirements achieve their functions during testing
 - Ensure **HSI** concerns are addressed when reviewing the **CI**'s test/analysis data, including software unit test results, to validate the intended function or performance stated in its specification is met
 - Audit **HSI** functional requirements against development test results to ensure satisfaction of all requirements
- Trades**
 - Ensure as the design is finalized, **HSI** considerations that affect the component level of the system are part of the decision making and trade studies that occur at this level of design
 - Participate in **HSI**-critical trade studies to ensure **HSI** concerns are addressed
 - Review results of all trade studies
- Post-CDR A**
 - Assess **HSI** risks against exit criteria for this acquisition phase
 - Identify those **HSI** risks that could result in a breach to the program baseline or substantially impact cost, schedule, or performance

The letters on this page correspond with the letters on the previous page and are associated with the respective SE step boxes.



Production and Deployment—The purpose of the Production and Deployment Phase is to achieve an operational capability that satisfies mission needs. Operational test and evaluation shall determine the effectiveness and suitability of the system. ([DODI 5000.02](#))

Production & Deployment Phase



Production & Deployment Phase

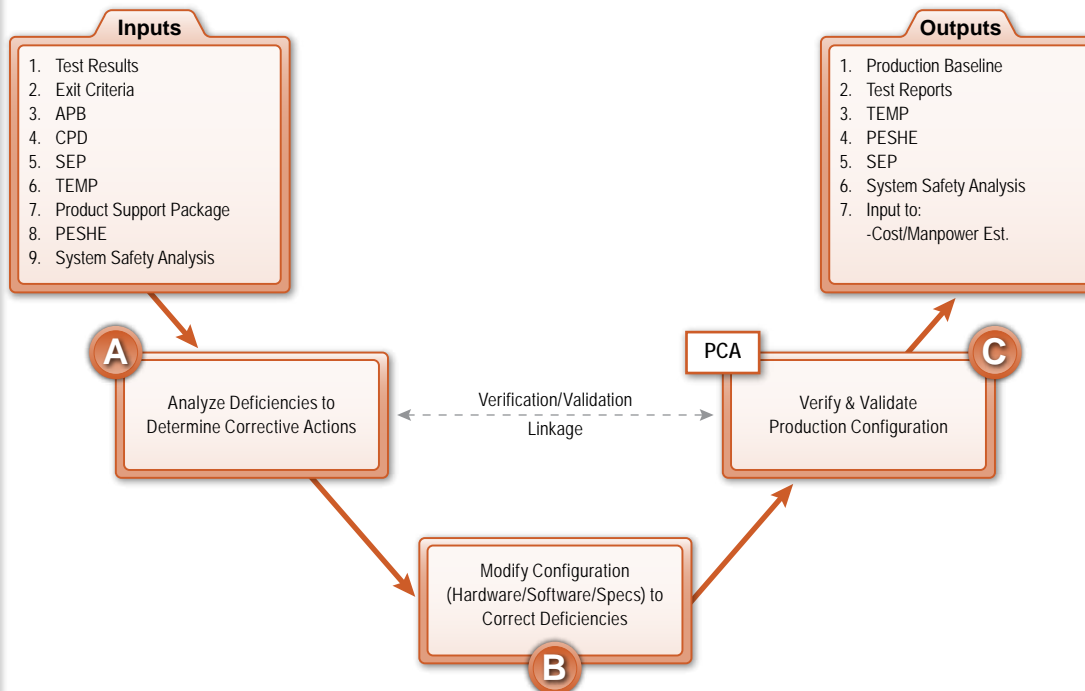
Human Systems Integration

Activities for Each Input:

- 1.0 Review integrated system results and identify **HSI** concerns
- 1.1 Document results of **HSI**-specific testing and identify planned corrective actions as appropriate
- 1.2 Leverage test results for **HSI** modifications
- 2.0 Document risk control measures of identified **HSI** constraints
- 3.0 Provide comprehensive **HSI** program inputs as required
- 4.0 Update **HSI** requirements and performance attributes to the system
- 5.0 Update strategy for incorporating **HSI** risk management into **SE**
- 5.1 Update **HSIP** with **HSI**-related concerns from operational test results
- 6.0 Monitor test planning to ensure **HSI** risk areas are being addressed
- 6.1 Revise to reflect modifications in **HSI** testing approach
- 7.0 Provide **HSI** updates to product support plans
- 8.0 Ensure inclusion of **HSI** risks and strategy for integration into **SEP**
- 9.0 Continue to monitor and track ongoing analysis results for **HSI** opportunities
- 9.1 Update with **HSI** inputs as required

References:

- [DODI 5000.02](#) & [DODD 5000.01](#)
- [DAG](#)
- [CJCSI 3170.01](#)
- [AFPD 63-1/AFPD 20-1](#)
- [AFI 63-101](#) & [AFI 63-1101](#)
- [AFI 63-1201](#)
- Domain-specific policies



Activities for Each Output:

- 1.0 Provide **HSI** updates based on Low Rate Initial Production (LRIP) and test results as required
- 2.0 Review test results for any **HSI** concerns and ensure appropriate corrective actions will be taken to address shortfalls.
- 2.1 Ensure trade-off decisions address **HSI**
- 3.0 Incorporate **HSI**-relevant data and further testing requirements
- 4.0 Coordinate with **ESOH SME's** for any required updates
- 4.1 Verify compliance with **NEPA** provisions
- 5.0 Update **HSI** risks and strategy for integration
- 5.1 Revise to reflect changes in **HSI** data or strategies
- 6.0 Review and include **HSI** inputs as required
- 7.0 Revise **MER** to reflect domain-specific changes and impacts

Tools:

- [IMPRINT](#)

The numbers in the Activities boxes correspond to the numbers in the Inputs and Outputs boxes.

Production and Deployment: Human Systems Integration

A

- Review deficiency reports (DR) for [HSI](#) implications
- Participate in development of [HSI](#) mitigation measures
- Participate in Configuration Control Board (CCB) to include reviewing [Engineering Change Proposals \(ECPs\)](#) for [HSI](#) implications
- Analyze effectiveness of recommended [NEPA/EO 12114](#) mitigation measures, and potential impacts on the natural environment
- Participate in planning of build, modification, verification, and test activities for the proposed design solution
- Assess the proposed design solution for correction of [HSI](#) deficiencies

B

- Verify [HSI](#) system requirements and constraints at testing and training locations
- Identify [HSI](#)-critical design and verification requirements
- Provide [HSI](#) risk review and acceptance for upcoming test activities as appropriate
- Balance [HSI](#) recommendations with system cost, schedule, and performance risks

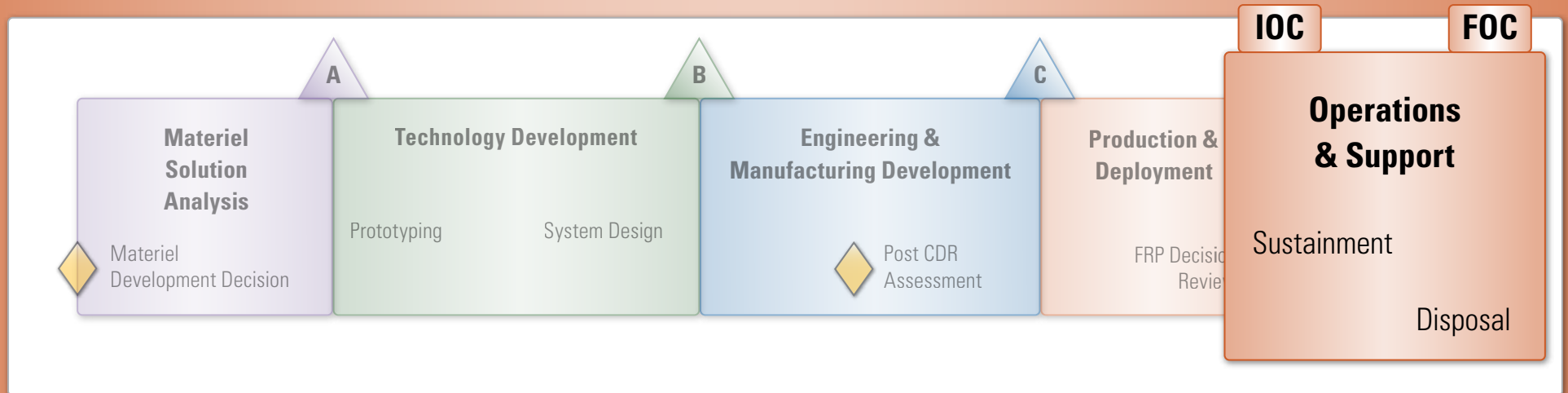
C

- Verify and validate [HSI](#)-critical design configuration
- Monitor testing and test results to validate [HSI](#)-relevant modifications are effective
- Incorporate approved [HSI](#) changes that resolve [HSI](#) issues in the final production configuration baseline

PCA

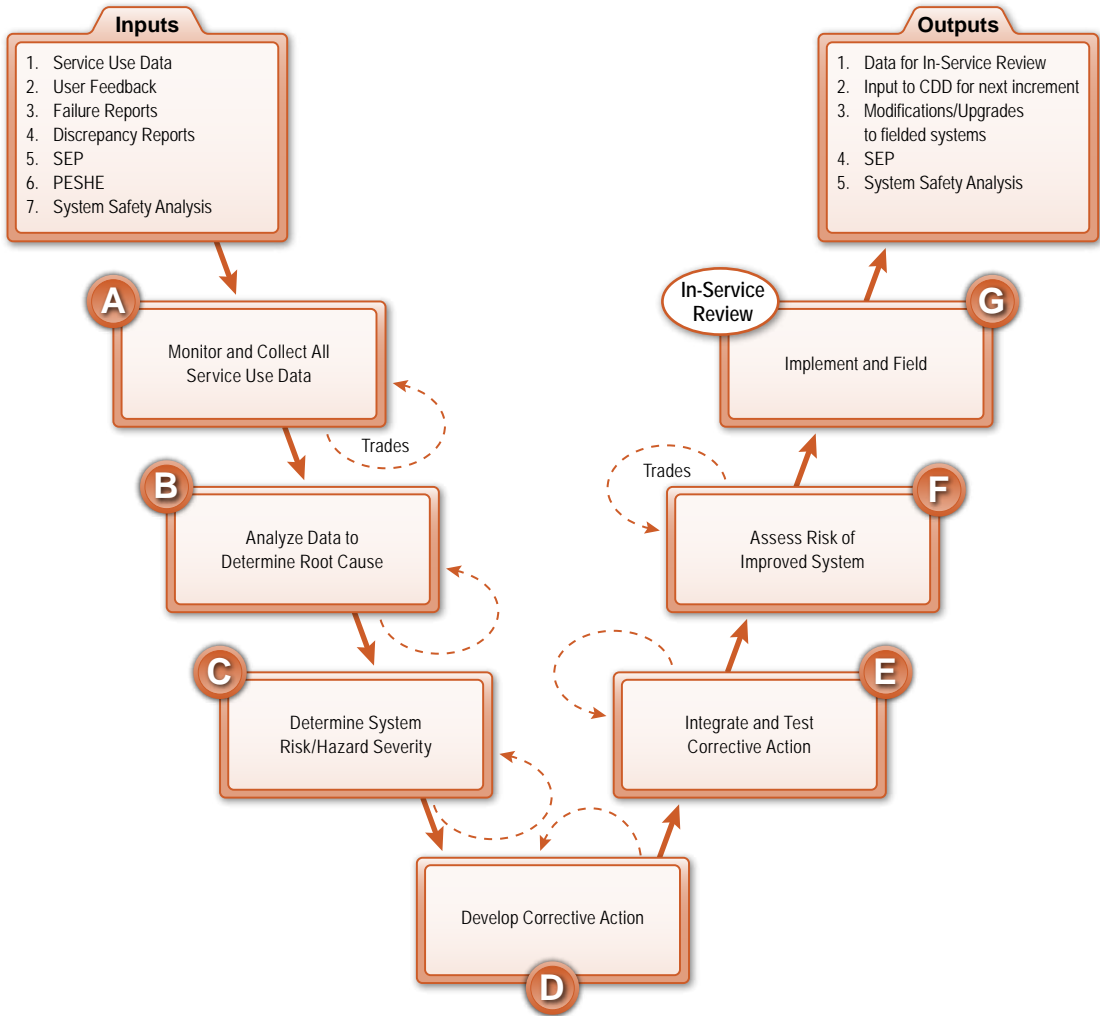
- Ensure human concerns are accounted for with testing, measuring, and controlling within the system
- Ensure [HSI](#) concerns are adequately planned, tracked, and controlled when confirming the manufacturing processes, quality control system, measurement, test equipment, and training
- Ensure the procured data package matches the as-built configuration
- Identify hazardous materials and processes in the technical data package

The letters on this page correspond with the letters on the previous page and are associated with the respective SE step boxes.



Operations and Support—The purpose of the Operations and Support Phase is to execute a support program that meets materiel readiness and operational support performance requirements, and sustains the system in the most cost-effective manner over its total life cycle. Operations and Support has two major efforts, Life-Cycle Sustainment and Disposal. ([DODI 5000.02](#))

Operations & Support Phase



Operations & Support Phase

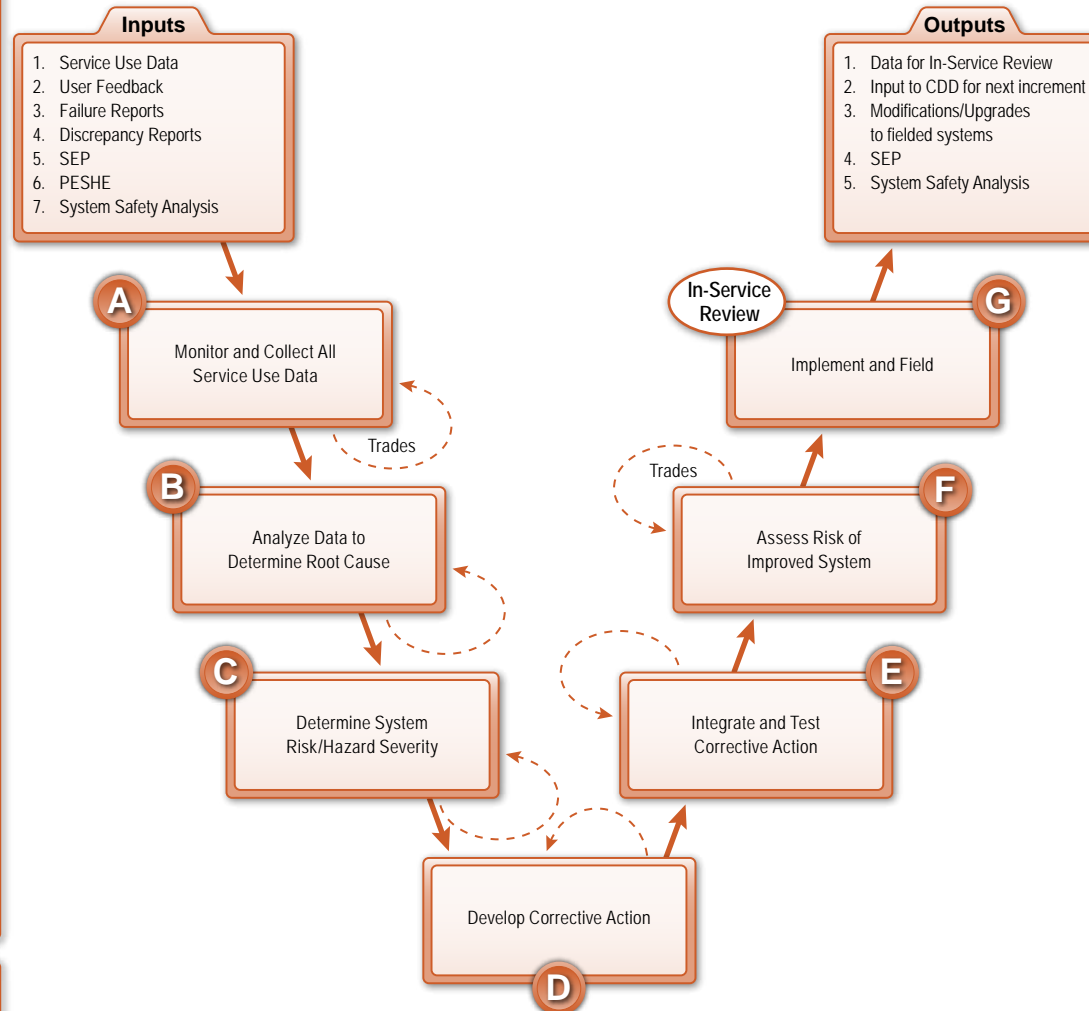
Human Systems Integration

Activities for Each Input:

- 1.0 Review [HSI](#)-related incident and mishap data reports
- 1.1 Identify [HSI](#)-related maintenance issues
- 1.2 Provide [HSI](#) inputs and constraints to system modifications
- 2.0 Solicit user inputs to identify [HSI](#) issues
- 2.1 Participate in system [HSI](#) working groups to highlight [HSI](#) opportunities
- 3.0 Review [HSI](#)-related incident and mishap data reports
- 3.1 Ensure domain [SMEs](#) review relevant reports
- 4.0 Review and analyze for [HSI](#) issues
- 4.1 Provide [HSI](#) inputs to trade-off analysis
- 5.0 Update strategy for merging [HSI](#) risk management into [SE](#)
- 5.1 Update [HSIP](#)
- 6.0 Ensure inclusion of [HSI](#) risks and strategy for incorporation into [PESHE](#)
- 7.0 Revise [HSI](#) data and analysis results

References:

- [DODI 5000.02](#) & [DODD 5000.01](#)
- [DAG](#)
- [CJCSI 3170.01](#)
- [AFPD 63-1/AFPD 20-1](#)
- [AFI 63-101](#) & [AFI 63-1101](#)
- [AFI 63-1201](#)
- Domain-specific policies



Activities for Each Output:

- 1.0 Update [HSI](#) risk assessment
- 1.1 Review [HSI](#) hazards and [DRs](#) from operations and maintenance
- 2.0 Document achievable [HSI](#) requirements for each incremental stage
- 2.1 Include [HSI](#) inputs as needed
- 3.0 Incorporate [HSI](#) analyses, impacts, and deficiency data
- 4.0 Review and update
- 4.1 Add any modifications and technology developments that are [HSI](#)-related
- 5.0 Revise to reflect domain-specific changes as required

Tools:

- [IMPRINT](#)

The numbers in the Activities boxes correspond to the numbers in the Inputs and Outputs boxes.

Operations and Support: Human Systems Integration

- A**
 - Provide system **HSI** criteria to engineering and logistics staff
 - Review data for **HSI**-influenced hazards (e.g., trend analysis)
 - Identify opportunities for technology insertion to reduce **HSI** risks
 - Analyze rates for Class A, B, and C mishaps for the system and subsystems for **HSI** causal factors
 - Review technical data change requests that may impact **HSI**
 - B**
 - Apply appropriate System Safety Analysis techniques to determine if **HSI** root causal factors exist
 - Evaluate data for **HSI** implications
 - Revise system's hazard analysis and risk tracking systems. Modify system status reports to reflect **HSI** impacts
 - C**
 - Prioritize **HSI**-related hazards for risk mitigation
 - Revise system's hazard analysis and risk tracking systems. Modify system status reports to reflect **HSI** impacts
 - D**
 - Apply system safety order of precedence to **HSI** corrective actions
 - Revise system's hazard analysis and risk tracking systems. Modify system status reports to reflect **HSI** impacts
 - Identify requirements for verification of **HSI** mitigation control measures
 - E**
 - Evaluate test results for risk mitigation effectiveness
 - Ensure control measures do not introduce latent problems into other domains, systems, human performance, or processes
 - Revise system's hazard analysis and risk tracking systems. Modify system status reports to reflect **HSI** impacts
 - F**
 - Conduct in-depth system analyses to ensure corrective measures and design modifications do not spawn additional deficiencies or degrade human performance
 - Recommend deficiency closure to appropriate risk acceptance authorities (updated residual risk)
 - Revise system's hazard analysis and risk tracking systems. Modify system status reports to reflect **HSI** impacts
 - G**
 - Continue to monitor and track system health, human performance indicators, mishaps, deficiencies, closure actions, mitigation measure effectiveness, and residual risk to validate enhancement efforts
-
- In-Service Review**

Trades

 - Ensure that **HSI** considerations are included during the risk, operational readiness, technical status, and trends assessments in a measurable form
 - Substantiate assessments with in-service support budget priorities
 - Include System Safety Working Group to support the System Hazard Risk Assessment
 - Review and update problem-reporting metrics
 - As corrective actions are incorporated into the system, **HSI** considerations that affect the system should be part of the decision making and trade studies that occur
 - Utilize **HSI** analysis to influence maintenance and modification trade-off decisions
 - Participate in **HSI**-critical trade studies and review results of all trade studies

The letters on this page correspond with the letters on the previous page and are associated with the respective SE step boxes.

Acronyms

Acronyms

A	AFHSIO	Air Force Human Systems Integration Office
	AFI	Air Force Instruction
	AFPD	Air Force Policy Document
	AoA	Analysis of Alternatives
	APB	Acquisition Program Baseline
	ASR	Acquisition Strategy Review
	ATB	Articulated Total Body
B	BCS	Baseline Comparison System
C	CARD	Cost Analysis Requirements Description
	CATIA	Computer Aided Three-Dimensional Interactive Application
	CCB	Configuration Control Board
	CDD	Capability Development Document
	CDR	Critical Design Review
	CDR-A	Critical Design Review Assessment
	CI	Configuration Item
	CJCSI	Chairman of the Joint Chiefs of Staff Instruction
	CJCSM	Chairman of the Joint Chiefs of Staff Manual
	CONOPS	Concept of Operations
D	DAG	Defense Acquisition Guidebook
	DoD	Department of Defense
	DODD	Department of Defense Directive
	DODI	Department of Defense Instruction
	DR	Deficiency Report
	DT&E	Developmental Test and Evaluation
E	ECP	Engineering Change Proposal
	EMD	Engineering and Manufacturing Development
	EO	Executive Order
	EOA	Early Operational Assessment
	ESOH	Environment, Safety, and Occupational Health
F	FCA	Functional Configuration Audit
	FOC	Full Operational Capability
	FRP	Full Rate Production
H	HMD	Head-Mounted Display
	HMI	Human-Machine Interface
	HSI	Human Systems Integration
	HSIP	Human Systems Integration Plan
I	IBR	Integrated Baseline Review
	ICD	Initial Capabilities Document
	IMPRINT	Improved Performance Research Integration Tool
	IPME	Integrated Performance Modeling Environment
	INCOSE	International Council on Systems Engineering
	IOC	Initial Operational Capability
	ISR	In-Service Review
	ITR	Initial Technical Review
L	LCMP	Life Cycle Management Plan
	LFT&E	Live Fire Test and Evaluation
	LRIP	Low Rate Initial Production

Acronyms

M	MER	Manpower Estimate Report
	MSA	Materiel Solution Analysis
N	NEPA	National Environmental Policy Act
	NEPA/EO	National Environmental Policy Act/Executive Order
O	O&S	Operations and Support
	O&SHA	Operations and Support Hazard Analysis
	OEM	Original Equipment Manufacturer
	OTRR	Operational Test Readiness Review
P	P&D	Production and Deployment
	PCA	Physical Configuration Audit
	PDR	Preliminary Design Review
	PDR-A	Preliminary Design Review Assessment
	PESHE	Programmatic Environment, Safety, and Occupational Health Evaluation
	PHA	Preliminary Hazard Analysis
	PHL	Preliminary Hazard List
	POC	Point of Contact
	PRR	Production Readiness Review

S	SE	Systems Engineering
	SEP	Systems Engineering Plan
	SFR	System Functional Review
	SHA	System Hazard Analysis
	SME	Subject Matter Expert
	SRR	System Requirements Review
	SSHA	Subsystem Hazard Analysis
	SURVIAC	Survivability/Vulnerability Information Analysis Center
T	SVR	System Verification Review
	TD	Technology Development
	TEMP	Test and Evaluation Master Plan
	TRA	Total Risk Assessment
	TRR	Test Readiness Review

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Glossary

Glossary

Term	Definition
Acquisition Program Baseline	Prescribes the key cost, schedule, and performance constraints in the phase succeeding the milestone for which they were developed. (CJCSI 3170.01G)
Analysis of Alternatives	The evaluation of the performance, operational effectiveness, operational suitability, and estimated costs of alternative systems to meet a mission capability. The analysis assesses the advantages and disadvantages of alternatives being considered to satisfy capabilities, including the sensitivity of each alternative to possible changes in key assumptions or variables. (CJCSI 3170.01G)
Baseline Comparison System	A current operational system, or a composite of current operational subsystems, which most closely represents the design, operational, and support characteristics of the new system under development. (DAG)
Capability Development Document	A document that captures the information necessary to develop a proposed program(s). The CDD outlines an affordable increment of militarily useful, logistically supportable, and technically mature capability, supporting a Milestone B decision review. (CJCSI 3170.01G)
Configuration Item	An aggregation of hardware, firmware, computer software, or any of their discrete portions, which satisfies an end use function and is designated by the government for separate configuration management. (DAG)
Engineering Change Proposal	A proposal to the responsible authority recommending that a change to an original item of equipment be considered, and the design or engineering change be incorporated into the article to modify, add or delete, or supersede original parts. (DAG)
Exit Criteria	Program specific accomplishments that must be satisfactorily demonstrated before a program can progress further in the current acquisition phase or transition to the next acquisition phase. (DAG)
First Article Testing	Production testing that is planned, conducted, and monitored by the materiel developer. It includes preproduction and initial production testing conducted to ensure that the contractor can furnish a product that meets the established technical criteria. (DAG)
Life Cycle Management Plan	Concise document that identifies relevant issues and recommends overall acquisition, program management, and life cycle support strategies. (DAG)

Tools

Tools

Name	Description	Applicability	
		Domain	Phase
ATB Model (Articulated Total Body Model)	The ATB model is a simulation program developed for the prediction of human body dynamics during aircraft ejection, aircraft crashes, automobile accidents, and other hazardous events. It is used in the Air Force to determine the safety of restraint systems, seats, escape systems, controls and displays, and other equipment in the aircraft cockpit during development. http://www.dtic.mil/dticasdl/ddsm/tools.html	• Human Systems Integration	• EMD-Inputs/Outputs
		• Safety	• MSA; TD-Inputs
CATIA (Computer Aided Three-Dimensional Interactive Application)	CATIA (V6) is a collective, integrated multi-disciplinary model for product development. CATIA's RFLP approach includes aggregating Requirements, Functional, Logical, and Physical product definitions. Meta-CAD modeling delivers a collaborative, liberated design environment. In addition to 3D system design, CATIA also integrates a 3D human modeling component to simulate human-system interaction in a virtual environment. http://www.3ds.com/products/catia/catia-discovery	• Human Systems Integration	• MSA; TD-Inputs/Outputs; EMD-Inputs/Outputs
		• Human Factors Engineering	• TD-Inputs/Outputs; EMD-Inputs/Outputs
		• Habitability	• MSA; TD-Inputs/Outputs; EMD-Inputs/Outputs; O&S
HSI Requirements Guide	The HSI Requirements Guide provides templated HSI requirements. This guide's purpose is three-fold: First, to assist requirements writers in documenting solid, unambiguous human requirements in AF and DoD level acquisition documents. Second, to assist HSI domain requirements writers in understanding where they fit into Integrated Defense Acquisition, Technology, and Logistics Life Cycle Management System. Finally, to serve as learning tool/quick reference source for HSI domain representatives who are called upon to assist with writing requirements documents.	• All Domains	• MSA
IMPRINT (Improved Performance Research Integration Tool)	An HSI tool developed by the U.S. Army Research Laboratory, Human Research & Engineering Directorate. It is a dynamic, stochastic discrete event network modeling tool designed to assess the interaction of soldier and system performance throughout the system life cycle—from concept and design through field testing and system upgrades. http://www.arl.army.mil/ARL-Directorates/HRED/imb/imprint/imprint7.htm	• Human Systems Integration	• All Phases
		• Human Factors Engineering	• MSA; TD-Inputs/Outputs
		• Habitability	• MSA; TD-Inputs/Outputs; EMD-Inputs/Outputs; O&S

Tools

Name	Description	Applicability	
		Domain	Phase
IPME (Integrated Performance Modeling Environment)	IPME is an integrated environment of models intended to help the human factors practitioner analyze human-system performance. IPME provides: a more realistic representation of humans in complex environments, interoperability with other model components and external simulations, enhanced usability through a user-friendly graphical user interface. IPME uses a process-oriented modeling approach and builds upon a SME's accounting of how operator activities are organized or may be organized to meet operational objectives. http://www.maad.com/index.pl/ipme	• Human Systems Integration	• TD-Inputs/Outputs; EMD-Inputs/Outputs
		• Human Factors Engineering	• MSA; TD-Inputs/Outputs; O&S

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Air Force Human Systems Integration Office

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